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MAPCO ALASKA PETROLEUM Inc.
LETTER OF TRANSMITTAL

MAPCO

USEPA - Seattle

DATE June 16, 1989

ATTENTION Bill Adams

RE MAPI Contractor Investigations

FROM Kathleen Buscovich

TRANSMITTAL NO.

FORWARDED VIA: US Express Mail LB121817542

COPY TO:

ATTACHED ARE FOR:

ITEM NO.	DATE	NO. OF COPIES	DESCRIPTION
1	6/16	1	Preliminary Report on Site Hydrogeology
1	6/16	1	Work Plan for Further Studies on Site Hydrogeology
1	6/16	1	Environmental Audit Report
1	6/16	1	Evaluation of Groundwater Flow, North Pole Refinery

REMARKS:

SIGNATURE OF SENDER

June 16, 1989
DATE

(2)

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Geotechnical Consultants
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September 24, 1987 K-0971-2

Mapco Alaska Petroleum, Inc.
1100 H&H Lane
North Pole, Alaska 99705

Attention: Ms. Kathleen McCullom

RE: EVALUATION OF GROUNDWATER FLOW, NORTH POLE REFINERY

Dear Ms. McCullom:

This letter presents the results of our recent evaluation of groundwater flow at the North Pole Refinery. This work was conducted in general accordance with our proposal to you dated September 10, 1987. The purpose of this work was to further investigate groundwater flow at the site, specifically with reference to vertical gradients at the north of the site and flow along the railroad spur.

Scope of Work

On September 14 and 15, 1987 one new monitoring well and four new sampling wells were installed at the site. On September 16, 1987 water levels were read in 19 recovery wells, 40 sampling, monitoring, and other wells, and 3 gravel pits on site. A survey of these points for elevation and horizontal location was performed by Design Alaska on September 16 through 19, 1987. Note that the recovery wells which were also surveyed in February, 1987 had heaved as much as 0.06 feet or settled as much as -0.06 feet since then. All but one of the S-series wells had heave, as much as 0.31 feet.

Table 1 presents the surveyed elevations of the wells used in this study. Table 2 presents the horizontal locations of these wells referenced to the refinery's coordinate system. Figure 1 is a plot plan of the well locations.

Water level measurements were made by John Cronin of our firm and Kathleen McCullom of Mapco. Water levels in the eight MW-series monitoring wells were measured with an electric water level sounder. A steel tape measure with water finding paste was used to measure depth to water (and depth to product, where applicable) in all other wells. Tables 3 through 10 present measured and calculated water/product level data. During the course of the measurements, the water table was dropping at the rate of 0.01 feet per 2 hours. The calculated potentiometric surface elevations were later corrected for this change before using them to plot groundwater surface contours.

Figure 2 is a contour plot of the potentiometric surface (the water table corrected for the presence of floating hydrocarbons in any wells) on September 16, 1987. This plot indicates the same general groundwater flow direction of about North 10° West which has been previously concluded from other data. However, the inclusion of the elevations of the three gravel pits on the plot reveals some of the localized differences in flow direction which exist at the site. On Figure 2, arrows have been drawn, at right angles to the water table contours, which indicate our inferred direction of groundwater movement. These arrows show that, superimposed upon the northerly regional gradient, there is flow into the south sides and out of the north sides of the gravel pits. This can also be seen in the 3-dimensional isometric plot of the water table surface presented in Figure 3.

It should be noted that all contour plots in this report were produced by a computer program using a Kriging algorithm. This results in some inevitable approximations and smoothing of the data. The scarcity of real data in some areas of the plots, particularly in the southwest corner, results in calculated data which, while they may be arithmetically correct, may not portray reality. In addition, the water levels plotted at the north end of the site are a mix of levels above and below permafrost. The plots have been included for visualization, and should be viewed in light of the cautions expressed above.

Discussion

Figure 2 indicates that on September 16, 1987 the general direction of groundwater flow at the site was about North 10° West. The overall gradient, measured from well S-19 to S-9, is 5.1 feet per mile. The gradient appears to flatten across the site to the north, from 6 feet per mile or greater at the south end to 4 feet per mile or less at the north end. This flattening may be due to the presence of permafrost north of the site, or may be a natural function of increasing distance from the Tanana River, which is recharging the aquifer.

For comparison, Figure 4 presents potentiometric surface contours based on February 4, 1987 measurements of only the S-series wells. These data indicate the same general direction of groundwater flow, and a slightly lower overall gradient (about 4.8 feet per mile from S-19 to S-9).

The installation of a shallow piezometer (S-25) adjacent to the Truck Rack Water Well (#4) allows vertical gradients to be examined at this location. In addition, surveyed elevations on the MW-series wells allows vertical gradients to be examined to the north and south of the refinery as well. Given an adjacent deep well and shallow well, a higher water level in the shallow well indicates the potential for downward water flow, and a higher water table in the deeper well indicates the potential for upward water flow. Note the indication of the "potential" for vertical flow. For instance, the MW-102/MW-103 pair are below and above a permafrost layer, which will not allow vertical flow. Tabulated below are the measured head differences, and the inferred direction of vertical groundwater flow, based on all available measurements from these well pairs.

Well Pair	MW-101 MW-101A	MW-102 MW-103	MW-105 MW-105A	Truck Rack S-25
Date		Head Difference in Feet		
4/7/87	.52 (up)	.26 (up)	.17 (up)	NA
5/6/87	.01 (down)	.53 (up)	.03 (down)	NA
8/26/87	.01 (up)	.65 (up)	.20 (up)	NA
9/16/87	0	.17 (down)	.17 (up)	.02 (down)

In our opinion, the measured head differences of only a few hundredths of a foot probably represent the limit of accuracy of the measurements, and most likely indicate no significant vertical flow. Thus no vertical flow is apparent at the Truck Rack Well.

MW-102 and MW-103 are about 200 feet apart, and thus some difference would be expected between these two wells. However, the change in magnitude of head difference and inferred direction indicates some change in the hydrology in this area during the year.

The two true pairs, MW-101/MW-101A and MW-105/MW-105A, generally indicate the potential for some upward flow. This may be the result of recharge from the Tanana River and/or permeability differences with depth in the formation.

The new piezometer installed along the railroad spur, S-26, confirms the existence of a gradient to the northeast along the spur. This gradient,

TABLE 3

WATER/PRODUCT LEVEL DATA

PROJECT LOCATION: NORTH POLE REFINERY
RECORDED BY: K. McCULLOM
DATE: SEPTEMBER 16, 1987

SPECIFIC GRAVITY OF PRODUCT: .78

WELL NO.	TIME	CASING RIM ELEVATION (FEET)	TAPE READING AT RIM	TAPE READING AT PRODUCT	TAPE READING AT WATER	DEPTH TO WATER (FEET)	WATER SURFACE ELEVATION (FEET)	PRODUCT THICKNESS (FEET)	POTENTIOMETRIC SURFACE ELEVATION (FEET)	COMMENTS
15	1550	496.68	11.00	0.40	0.16	10.84	485.84	0.24	486.03	R-13
18	1605	498.65	13.00	0.53	0.31	12.69	485.96	0.22	486.13	R-18

TABLE 4

WATER/PRODUCT LEVEL DATA

PROJECT LOCATION: NORTH POLE REFINERY
RECORDED BY: K. McCULLOM / J. CRONIN
DATE: SEPTEMBER 16, 1987

SPECIFIC GRAVITY OF PRODUCT: .81

WELL NO.	TIME	CASING RIM ELEVATION (FEET)	TAPE READING AT RIM	TAPE READING AT PRODUCT	TAPE READING AT WATER	DEPTH TO WATER (FEET)	WATER SURFACE ELEVATION (FEET)	PRODUCT THICKNESS (FEET)	POTENTIOMETRIC SURFACE ELEVATION (FEET)		COMMENTS
1	1555	493.98	9.00	0.54	0.29	8.71	485.27	0.25	485.47	R-1	
3	1300	493.99	7.50	0.88	0.40	7.10	486.89	0.48	487.28	R-3	
8	1330	495.19	9.65	0.50	0.00	9.65	485.54	0.50	485.95	R-7	NO WATER IN HOLE BEL
9	1335	494.40	9.65	1.16	0.00	9.65	484.75	1.16	485.69	R-8	NO WATER IN HOLE BEL
10	1545	494.09	9.01	1.21	0.30	8.71	485.38	0.91	486.12	R-9	
19	1607	498.08	14.50	3.26	0.11	14.39	483.69	3.15	486.24	R-19	
20	1615	499.10	15.30	3.10	0.35	14.95	484.15	2.75	486.38	R-20	
39	1620	497.88	14.90	4.02	0.31	14.59	483.29	3.71	486.30	S-20	
41	1635	497.79	14.50	3.83	0.54	13.96	483.83	3.29	486.49	S-22	

TABLE 5

WATER/PRODUCT LEVEL DATA

PROJECT LOCATION: NORTH POLE REFINERY
RECORDED BY: K. McCULLOM
DATE: SEPTEMBER 16, 1987

SPECIFIC GRAVITY OF PRODUCT: .82

WELL NO.	TIME	CASING RIM ELEVATION (FEET)	TAPE READING AT RIM	TAPE READING AT PRODUCT	TAPE READING AT WATER	DEPTH TO WATER (FEET)	WATER SURFACE ELEVATION (FEET)	PRODUCT THICKNESS (FEET)	POTENTIOMETRIC SURFACE ELEVATION (FEET)	COMMENTS
2	1255	494.01	7.50	0.68	0.45	7.05	486.96	0.23	487.15	R-2
4	1200	494.59	8.00	0.59	0.39	7.61	486.98	0.20	487.14	R-4
11	1410	495.00	9.50	0.91	0.50	9.00	486.00	0.41	486.34	R-10
12	1415	492.78	7.00	0.61	0.22	6.78	486.00	0.39	486.32	R-10A
13	1400	495.02	9.50	0.88	0.45	9.05	485.97	0.43	486.32	R-11

TABLE 6

WATER/PRODUCT LEVEL DATA

PROJECT LOCATION: NORTH POLE REFINERY
RECORDED BY: K. McCULLOM
DATE: SEPTEMBER 16, 1987

SPECIFIC GRAVITY OF PRODUCT: .82

WELL NO.	TIME	CASING RIM ELEVATION (FEET)	TAPE READING AT RIM	TAPE READING AT PRODUCT	TAPE READING AT WATER	DEPTH TO WATER (FEET)	WATER SURFACE ELEVATION (FEET)	PRODUCT THICKNESS (FEET)	POTENTIOMETRIC SURFACE ELEVATION (FEET)	COMMENTS
14	1420	493.81	8.50	0.96	0.33	8.17	485.64	0.63	486.16	R-12

TABLE 7

WATER/PRODUCT LEVEL DATA

PROJECT LOCATION: NORTH POLE REFINERY
RECORDED BY: K. McCULLOM
DATE: SEPTEMBER 16, 1987

SPECIFIC GRAVITY OF PRODUCT: .84

WELL NO.	TIME	CASING RIM ELEVATION (FEET)	TAPE READING AT RIM	TAPE READING AT PRODUCT	TAPE READING AT WATER	DEPTH TO WATER (FEET)	WATER SURFACE ELEVATION (FEET)	PRODUCT THICKNESS (FEET)	POTENTIOMETRIC SURFACE ELEVATION (FEET)	COMMENTS
16	1445	493.94	8.77	0.56	0.30	8.47	485.47	0.26	485.69	R-14
17	1455	493.73	9.30	1.43	0.33	8.97	484.76	1.10	485.68	R-14A

TABLE 8

WATER/PRODUCT LEVEL DATA

PROJECT LOCATION: NORTH POLE REFINERY
RECORDED BY: K. McCULLOM
DATE: SEPTEMBER 16, 1987

SPECIFIC GRAVITY OF PRODUCT: .86

WELL NO.	TIME	CASING RIM ELEVATION (FEET)	TAPE READING AT RIM	TAPE READING AT PRODUCT	TAPE READING AT WATER	DEPTH TO WATER (FEET)	WATER SURFACE ELEVATION (FEET)	PRODUCT THICKNESS (FEET)	POTENTIOMETRIC SURFACE ELEVATION (FEET)	COMMENTS
5	1427	495.43	9.50	1.13	0.38	9.12	486.31	0.75	486.96	R-5
6	1435	496.68	10.50	0.70	0.59	9.91	486.77	0.11	486.86	R-5A

TABLE 9

WATER/PRODUCT LEVEL DATA

PROJECT LOCATION: NORTH POLE REFINERY
RECORDED BY: J. CRONIN/K. McCULLOM
DATE: SEPTEMBER 16, 1987

SPECIFIC GRAVITY OF PRODUCT: .81

WELL NO.	TIME	CASING RIM ELEVATION (FEET)	TAPE READING AT RIM	TAPE READING AT PRODUCT	TAPE READING AT WATER	DEPTH TO WATER (FEET)	WATER SURFACE ELEVATION (FEET)	PRODUCT THICKNESS (FEET)	POTENTIOMETRIC SURFACE ELEVATION (FEET)	COMMENTS 9/16/87
21	1556	494.16	6.80	0.00	0.15	6.65	487.51	0.00	487.51	S-1
22	1302	496.71	9.80	0.00	0.15	9.65	487.06	0.00	487.06	S-2A
23	1305	493.47	6.70	0.00	0.13	6.57	486.90	0.00	486.90	S-3
24	1316	495.45	9.10	0.00	0.13	8.97	486.48	0.00	486.48	S-4
25	1320	495.60	9.40	0.00	0.17	9.23	486.37	0.00	486.37	S-5
26	1325	492.30	6.30	0.00	0.13	6.17	486.13	0.00	486.13	S-6
27	1339	495.06	9.60	0.00	0.16	9.44	485.62	0.00	485.62	S-8
28	1333	493.97	8.40	0.00	0.12	8.28	485.69	0.00	485.69	S-8A
29	1400	496.10	10.80	0.00	0.11	10.69	485.41	0.00	485.41	S-9
30	1407	494.65	9.30	0.00	0.14	9.16	485.49	0.00	485.49	S-10
31	1412	497.23	11.70	0.00	0.16	11.54	485.69	0.00	485.69	S-11
32	1419	496.58	11.00	0.00	0.19	10.81	485.77	0.00	485.77	S-12
33	1431	496.21	10.50	0.00	0.17	10.33	485.88	0.00	485.88	S-13
34	1427	496.81	10.90	0.00	0.17	10.73	486.08	0.00	486.08	S-13A
35	1531	496.80	10.80	0.00	0.12	10.68	486.12	0.00	486.12	S-14
36	1437	497.23	10.20	0.00	0.17	10.03	487.20	0.00	487.20	S-17
37	1545	498.30	10.60	0.00	0.13	10.47	487.83	0.00	487.83	S-18A
38	1549	495.43	7.70	0.00	0.12	7.58	487.85	0.00	487.85	S-19
42	1705	496.09	10.30	0.00	0.18	10.12	485.97	0.00	485.97	S-23
43	1630	495.96	9.30	0.00	0.18	9.12	486.84	0.00	486.84	S-24
44	1212	497.06	11.50	0.00	0.16	11.34	485.72	0.00	485.72	S-25
45	1159	495.65	10.40	0.00	0.11	10.29	485.36	0.00	485.36	S-26

TABLE 10

WATER/PRODUCT LEVEL DATA

PROJECT LOCATION: NORTH POLE REFINERY
RECORDED BY: J. CRONIN
DATE: SEPTEMBER 16, 1987

SPECIFIC GRAVITY OF PRODUCT: .81

WELL NO.	TIME	CASING RIM ELEVATION (FEET)	TAPE READING AT RIM	TAPE READING AT PRODUCT	TAPE READING AT WATER	DEPTH TO WATER (FEET)	WATER SURFACE ELEVATION (FEET)	PRODUCT THICKNESS (FEET)	POTENTIOMETRIC SURFACE ELEVATION (FEET)	COMMENTS
47	1445	494.77	8.10	0.00	0.16	7.94	486.83	0.00	486.83	CONSTRUCTION WELL
48	1349	494.24	8.50	0.00	0.16	8.34	485.90	0.00	485.90	DISTRIBUTION WELL
49	1227	494.11	8.60	0.00	0.19	8.41	485.70	0.00	485.70	TRUCK RACK WELL
50	920	495.27	9.97	0.00	0.00	9.97	485.30	0.00	485.30	MW-101
51	922	493.26	7.96	0.00	0.00	7.96	485.30	0.00	485.30	MW-101A
52	1047	493.38	8.25	0.00	0.00	8.25	485.13	0.00	485.13	MW-102
53	1116	494.09	8.79	0.00	0.00	8.79	485.30	0.00	485.30	MW-103
54	1129	496.45	11.54	0.00	0.00	11.54	484.91	0.00	484.91	MW-104
55	951	497.50	9.43	0.00	0.00	9.43	488.07	0.00	488.07	MW-105A
56	953	497.85	9.61	0.00	0.00	9.61	488.24	0.00	488.24	MW-105
57	933	497.49	11.19	0.00	0.00	11.19	486.30	0.00	486.30	MW-106
58	1506	495.39	10.20	0.00	0.18	10.02	485.37	0.00	485.37	OM-1
59	1703	496.15	10.85	0.00	0.13	10.72	485.43	0.00	485.43	OM-2
60	1521	494.07	8.50	0.00	0.22	8.28	485.79	0.00	485.79	M-2
61	1451	492.83	6.30	0.00	0.12	6.18	486.65	0.00	486.65	M-3
62	1538	492.32	6.00	0.00	0.11	5.89	486.43	0.00	486.43	M-4
25	1642	495.60	9.40	0.00	0.15	9.25	486.35	0.00	486.35	S-5 CLOSURE
28	1645	493.97	8.40	0.00	0.10	8.30	485.67	0.00	485.67	S-8A CLOSURE

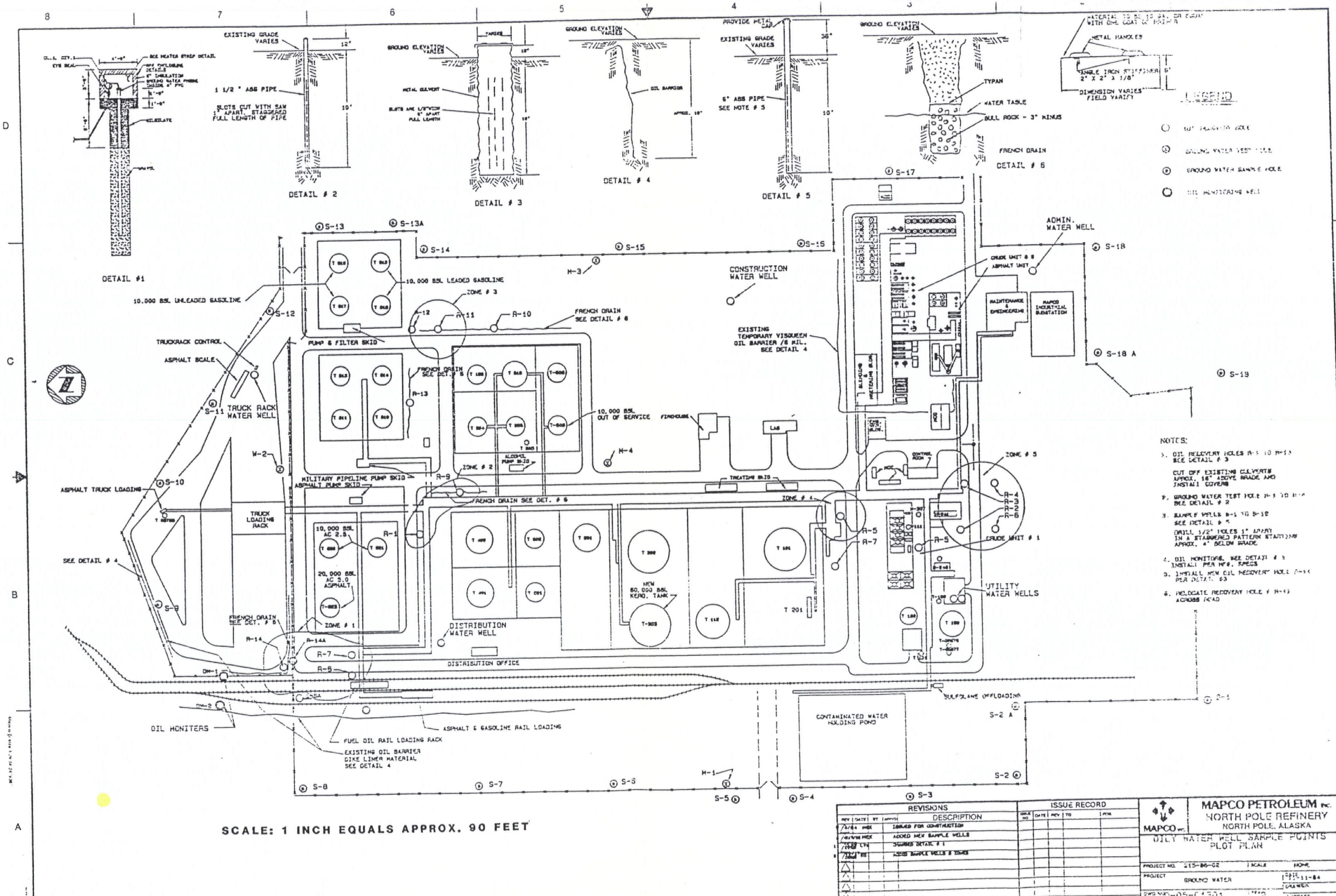
DETAIL #1
EXISTING GRADE VARIES
1 1/2" ABS PIPE
SLOTS CUT WITH SAW 1" APART, STAGGERED FULL LENGTH OF PIPE
DETAIL # 2
GROUND ELEVATION VARIES
METAL CULVERT
DETAIL # 3
GROUND ELEVATION VARIES
OIL BARRIER
DETAIL # 4
PROVIDE METAL CAP
EXISTING GRADE VARIES
6" ABS PIPE SEE NOTE # 3
DETAIL # 5
GROUND ELEVATION VARIES
TYPAR
WATER TABLE
BULL ROCK - 3" MINUS
FRENCH DRAIN
DETAIL # 6
METAL HANDLES
DIMENSION VARIES FIELD VERIFY
LEGEND
S-13
S-13A
S-14
S-15
S-16
S-17
S-18
S-18 A
S-19
S-12
S-11
S-10
S-9
S-8
S-7
S-6
S-5
S-4
S-3
S-2
S-2 A
H-1
H-2
H-3
H-4
10,000 BBL UNLEADED GASOLINE
10,000 BBL LEADED GASOLINE
ZONE # 3
FRENCH DRAIN SEE DETAIL # 6
TRUCKRACK CONTROL
ASPHALT SCALE
TRUCK RACK WATER WELL
PUMP & FILTER SKID
CONSTRUCTION WATER WELL
EXISTING TEMPORARY VISQUEEN OIL BARRIER /6 MIL. SEE DETAIL 4
ADMIN. WATER WELL
10,000 BBL OUT OF SERVICE
FIREHOUSE
LAB
MILITARY PIPELINE PUMP SKID
ASPHALT PUMP SKID
ZONE # 2
FRENCH DRAIN SEE DET. # 6
TREATING SKID
ZONE # 4
ZONE # 5
CRUDE UNIT # 1
ASPHALT TRUCK LOADING
TRUCK LOADING RACK
SEE DETAIL # 4
10,000 BBL AC 2.5
20,000 BBL AC 5.0 ASPHALT
ZONE # 1
NEW 50,000 BBL KERO. TANK
T 201
DISTRIBUTION WATER WELL
DISTRIBUTION OFFICE
UTILITY WATER WELLS
SULFOLANE OFFLOADING
CONTAMINATED WATER HOLDING POND
OIL MONITERS
FUEL OIL RAIL LOADING RACK
ASPHALT & GASOLINE RAIL LOADING
EXISTING OIL BARRIER DIKE LINER MATERIAL SEE DETAIL 4
NOTES:
SCALE: 1 INCH EQUALS APPROX. 90 FEET
REVISIONS
DESCRIPTION
ISSUED FOR CONSTRUCTION
ADDED NEW SAMPLE WELLS
ISSUE RECORD
MAPCO PETROLEUM INC.
NORTH POLE REFINERY
NORTH POLE, ALASKA
OILY WATER WELL SAMPLE POINTS
PLOT PLAN
PROJECT
GROUND WATER

FIG. 2

61.15

61.15
4.38